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AERONUTRONIC DIVISION

Publication No. U-1797

SPACE AND WEAPON SYSTEMS

TECHNICAL REPORT

FOURTEENTH BIMONTHLY TECHNICAL PROGRESS REPORT A LUNAR SEISMOMETER CAPSULE SUBSYSTEM FOR RANGER

Prepared for:	Jet Propulsion Laboratory California Institute of Technology Pasadena, California
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Prepared by:	Spacecraft Projects
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August 1962

Ford Motor Company
AERONUTRONIC DIVISION

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Ford Motor Company,
AERONUTRONIC DIVISION

LUNAR SEISMOMETER CAPSULE SUBSYSTEM FOR RANGER

1. SUMMARY

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Aeronutronic Division of Ford Motor Company, under a JPL sub-contract, has developed a complete lunar capsule subsystem for Rangers 3, 4, and 5. Capsules have been supplied for Rangers 3 and 4 on schedule and with no significant deviations from specifications.

The major effort during the June - July reporting period has been directed toward the fabrication and assembly of Ranger 5 flight hardware. The major engineering programs for modification of capsule electronics have been completed, and the resulting parts have been tested satisfactorily. In all cases the design objectives were achieved. This modification effort included significant changes in the capsule transmitter, sequence timer, and squib switch assembly.

Major changes in the ancillary equipment are confined to the power and sequencing assembly and external wiring. The wiring changes have been completed and satisfactorily tested; the test model of the new power and sequencing unit is being readied for test.

Preparations for the AMR operations are underway. All field procedures have been reviewed and modified as required by system changes or experience from the Ranger 4 launch. The specific field crew has been selected, and responsibilities have been assigned. Shipping schedules for field support equipment and flight hardware have been established and coordinated with JPL field operations schedules.

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2. ENGINEERING AND TEST EFFORT

a. Survival Sphere

(1) Capsule Transmitter

Two Ranger 5 flight transmitters which incorporate redesign areas presented on pages 2 and 3 of the Thirteenth Bimonthly Technical Report, A Lunar Seismometer Capsule Subsystem for Ranger, Publication No. U-1743, have been fabricated and tested.

The new layout of critical bypass elements in the buffer amplifier and power amplifier circuits has minimized ground loop problems which had previously caused difficulty with tuning and stable adjustment of modulation index.

Addition of a trimpot to adjust the 560-cycle subcarrier input amplitude to the phase modulator has decreased modulation index adjustment time. Previously this adjustment was made by selecting values of a capacitive divider; the limitation imposed by standard capacitor value restricted the accuracy of adjustment and required much longer adjustment time.

All JFD glass and quartz dielectric trimmer capacitors have been replaced with Johanson ceramic body air-dielectric units. The Q of the Johanson capacitors is from 3 to 4 times that of the glass dielectric units, resulting in less circuit loss and a noticeable increase in efficiency. Because the body of these units is made of alumina, they are much more rugged than the trimmer capacitors which were previously used. Extensive shock testing produced no measurable capacity change or momentary shorting at impact. These three electrical changes have resulted in a much more stable and reproducible transmitter with increased impact resistance. Numerous other mechanical design changes, such as bushing cable routing holes in the chassis, re-layout of the VCO post-amplifier and improvement of cavity and cavity feed design, provide a more reliable unit while decreasing overall assembly time. A photograph of the new VCO post-amplifier board is shown in Figure 1. The new printed circuit board replaces the wired terminal board used in previous transmitters. The new design results in an improved circuit layout and facilitates the fabrication of the assembly.

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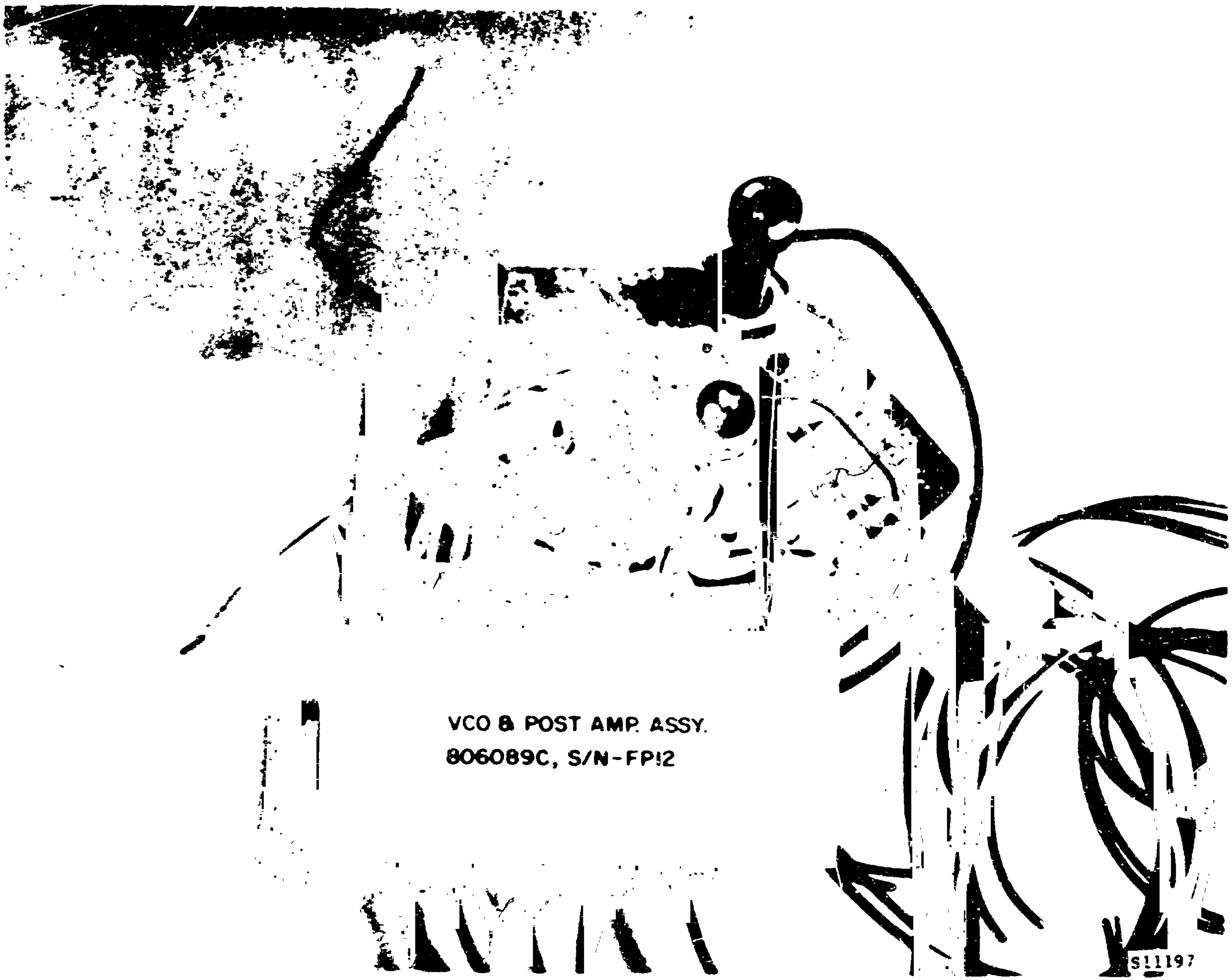

FIGURE 1. POST-AMPLIFIER ASSEMBLY

(2) Sequence Timer

The sequence timer has been redesigned using welded circuit packaging techniques to maintain the high component packing density requirements, while at the same time not compromising the reproducibility, quality assurance, and operational reliability requirements of the flight hardware. Conversion to this welded module approach has eliminated the severe fabrication problems present in the previous high density soldered assembly, such as soldering within 1/32 of an inch of component bodies, sharp bending of component leads, teflon insulation cold flow conditions, and severe limitations on the quality control of the unit.

The sequence timer welded module is rather unique in that the large number of circuit interconnections required has resulted in a multilayer module. It is a cordwood package with five layers of welded interconnections separated by 0.007-in. mylar wafers. The appropriate interconneccion layout has been photo-reproduced on each wafer and these serve as guides for assembly and inspection, in addition to insulating the individual layers. The welded assembly is subsequently encapsulated with a semirigid epoxy system. Electrical outputs are provided by standard terminals mounted on an epoxy fiberglass header board. Lead outputs from the circuit module are welded to these terminals. The terminals provide a convenient means for external connection to the timer without presenting any possibility of damaging the encapsulated timer assembly.

Complete specifications covering design, fabrication, and quality assurance of welded circuit modules for the lunar capsule development program have been generated. In conjunction with these, detailed assembly procedures, equipment and process control procedures, and in-process inspection records are followed during the fabrication of each module assembly.

Two design proof test (DPT) units of the new sequence timer have been fabricated and type tested. These units were entirely successful. Flight parts 11 and 12 are also complete through acceptance test.

The redesign of the sequence timer has produced an assembly of greatly improved quality and also has increased significantly the reproducibility of the unit. Approximately one-half the number of fabrication hours required to build the previous design are necessary to build the redesigned sequence timer.

Photographs showing the sequence timer during various stages of fabrication are included with this report. Figure 2 shows the assembly with the components in place between the mylar wafers. There are 114

FIGURE 2. SEQUENCE TIMER COMPONENTS PRIOR TO WELDING

components in this module. Figure 3 shows the assembly after completion of the welding. A completed assembly is shown in Figure 4. The module shown in this figure is ready for encapsulation.

(3) Squib Switch Assembly

The redesign of the squib switch assembly has been completed. Two design proof test models were fabricated and tested. The results of the tests were satisfactory for both units.

The new design incorporates Atlas squib switches which have a higher no-fire current and may be heat-sterilized.

A photograph of a partially completed squib switch assembly is shown in Figure 5, and a completed assembly is shown in Figure 6. The new design uses printed circuit boards rather than the point-to-point wired terminal board which was previously used. This has minimized the wiring complexity and results in simplification of the assembly procedure.

(4) RFI Investigation

The RFI investigation has been terminated, and a complete report (ADF Publication No. SCPS-30, dated July 12, 1962) has been published by Aeronutronic. Additional work has been done at JPL on the transmitter removed from Capsule 10, the original Ranger 3 flight unit. Results of this study are included in a JPL memo ERG No. 134.

Results from all of these tests point to the desirability of having a suitable high sensitivity (-140 dbm) receiver available when tuning lunar capsule transmitters to minimize the possibility of delivering a unit with excessive 890.040-mc output.

Present plans call for a compatibility check on the JPL PTM of all flight transmitters before sphere buildup.

(5) Component Qualification

Components to be used in Ranger 5 capsules are being qualified according to Aeronutronic Specification 806202 and 806203.

Approximately 75 percent of all components have been lot qualified and it is expected that lot qualification will be completed by August 24,1962.

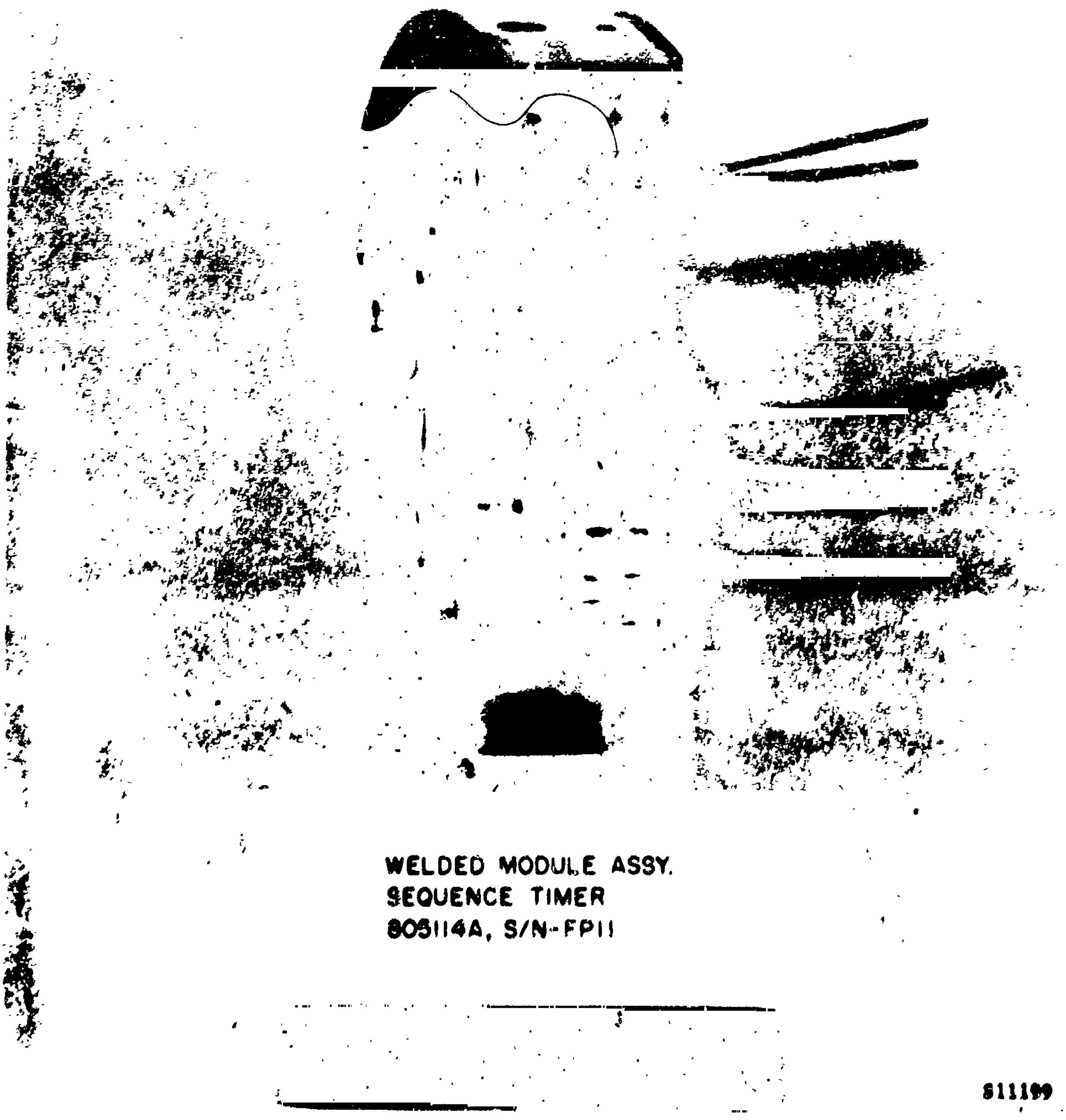

FIGURE 3. SEQUENCE TIMER ASSEMBLY PRIOR TO POTTING

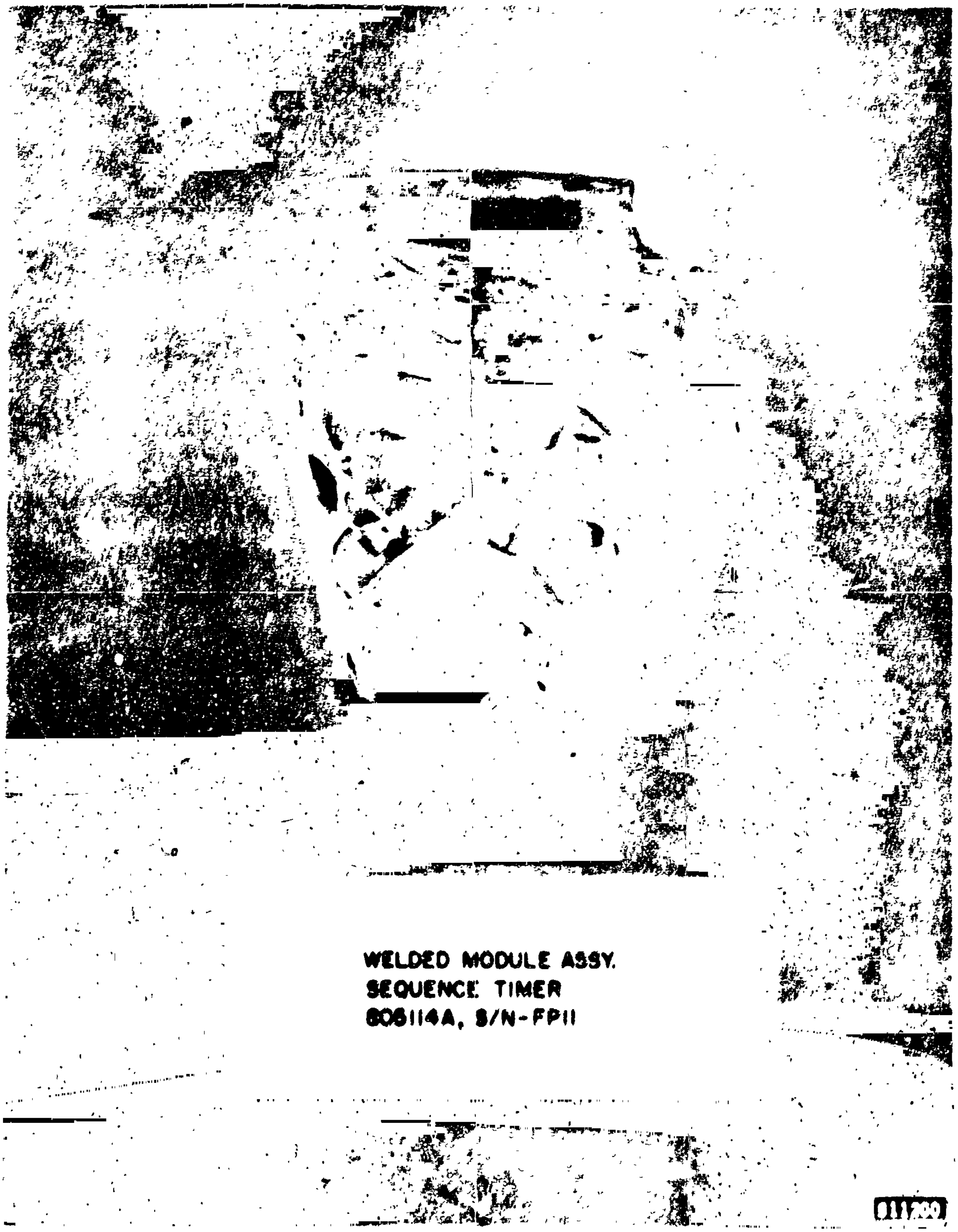

FIGURE 4. SEQUENCE TIMER FINAL ASSEMBLY

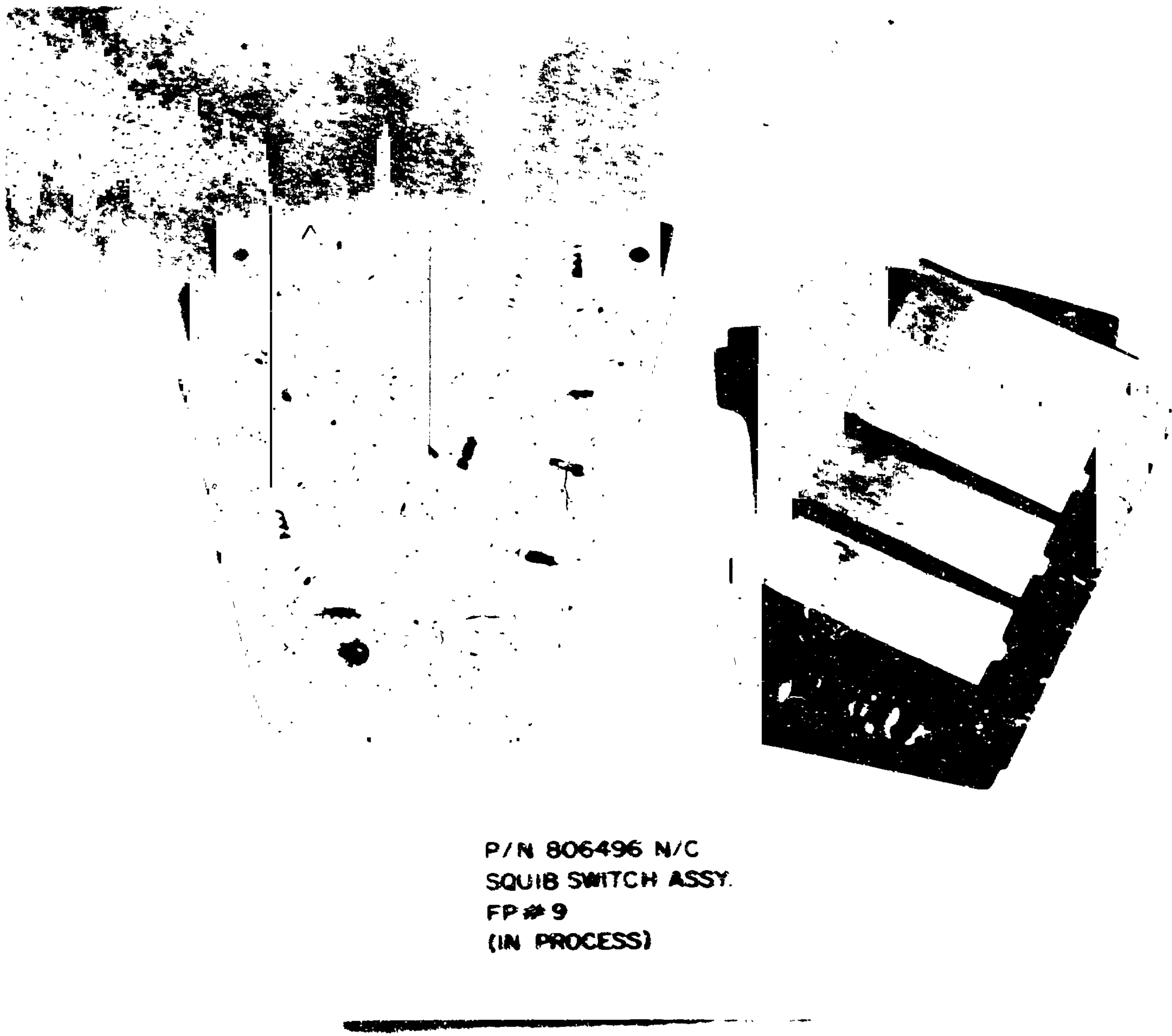

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FIGURE 5. PRINTED CIRCUIT BOARD SQUIB SWITCH

FIGURE 6. SQUIB SWITCH ASSEMBLY

To date only one lot has failed to qualify. These were Texas Instruments' 150-μfd tantalum capacitors from the Ranger 3 and 4 residuals. The symptom of failure was a marked increased in dc leakage current after shock test. U. S. Semcor's 180-μfd capacitors are now being used and have survived all qualification tests.

A file of lot qualification data is being maintained by engineering. This includes test data charts, photographs of accelerometer g-levels as traced on an oscilloscope, and special test procedures.

Qualified components are being marked and stored in the bond stock room as qualified lots.

(6) Sphere 15 Test

The Sphere 15 thermal tests were started on June 29, 1962, and completed on July 24, 1962. The primary test objective was to determine if adequate thermal protection is afforded by the thermal valve and insulation under simulated lunar vacuum and thermal environment. The transmitter was operated continuously and monitored periodically to determine operational characteristics in the lunar environment.

The sphere was constructed with instrumentation leads penetrating the limiter for external monitoring and control as follows:

(a) Actuation of the timer by connecting leads across the 25-g switch and monitoring the occurrence of the event

(b) Monitoring of battery voltage

(c) Monitoring of inner sphere temperature

(d) Monitoring of transmitter power and transmitter carrier frequency

The instrumentation set-up is shown in Figure 7.

The test was conducted in the Aeronutronic Vacuum Chamber Facility shown in Figure 8. The chamber contained a copper thermal jacket which was cooled by liquid nitrogen and heated by circulating heated water. The jacket was maintained at +200°F during the hot cycle (lunar day) and -280°F during the cold cycle (lunar night).

FIGURE 7. SPHERE 15 THERMAL TEST INSTRUMENTATION

FIGURE 8. SPHERE SIMULATION CHAMBER - THERMAL TEST OF SPHERE 15

The test was started in a manner to simulate a lunar landing on the dark side of the moon. The sphere was held under vacuum for 60 hr at ambient temperature. The cold wall was turned on 45 minutes prior to penetrator timer start, and at the time of penetrator firing was at temperatures of -250°F. The cold cycle was continued until the internal temperature reached 32°F. At this time the liquid nitrogen flow was stopped, and the jackets were converted to a hot cycle.

During the cold cycle the equilibrium heat loss rate through the insulation and associated conductances was 7.7 w at 1 to 3 µ chamber pressure. A correction for chamber pressure predicts a heat loss rate of approximately 4 w for a lunar night landing without impact degradation of the insulation. The analogous corrected heat loss rate predicted for the lunar day is slightly in excess of 2 w. A cold test performed subsequent to the removal of all boil-off and flotation fluid contamination indicates that an additional 50-percent reduction in night heat loss rates can be gained by landing and initiating operation during the lunar day. A comprehensive report interpreting these results in terms of payload performance on the lunar surface is in progress.

The Sphere 15 was installed in the vacuum chamber and measurements of transmitter output power, frequency, etc., were made. The results of these checks and data from acceptance tests is shown in Table 1.

TABLE 1

SPHERE 15 TEST DATA

Acceptance Test Data	
Carrier frequency (at 70°F)	960.154020 mc
Carrier power	52.5 mw
Pre-thermal Test Data	
Carrier frequency	960.157390 mc
Carrier power	76.8 db above 1 µ v/mc
VCO frequency	560 cps
9-v battery	9.4907
6-v battery	6.299
Post-thermal Test Data	
Carrier frequency	960.154020
Carrier power	52.5 mw
9-v battery	* 8.240
6-v battery	* 2.182

*At time of first indication of battery failure

A transmitter carrier signal level change was noted at the time of penetrator firing and during a period when ice formed on the sphere and instrumentation wiring. Except for these instances, the signal level remained at essentially the level observed at the start of the test until the temperature of the inner sphere reached -36°F at which time the 6-v battery voltage dropped to 2 v.

Battery voltage levels changed less than 0.3v until battery failure occurred. The temperature of the payload was recorded as -36°F at the time an abnormally low battery voltage was noted.

During the test no abnormal variations in transmitter operation or in battery voltages were observed until failure of the battery occurred. A rupture of the battery case was found at the time the inner sphere was opened for removal of the transmitter.

(7) DPT-6

The Ranger 5 lunar capsule assembly incorporated changes which require design proof test requalification. The design proof test program was conducted for both internal and external components. The hardware which was qualified included the transmitter, sequence timer, squib switch assembly within the capsule, and the external wiring and altimeter structure external to the capsule.

The DPT-I transmitter, DPT-I sequence timer, and DPT-I squib switch assembly were impact tested on the Hyge sled in the component fixture. The shock pulse was 3000 g for 4 msec. The post-impact evaluation indicated completely satisfactory operation of all components. On the basis of the sled test performance, the fabrication of the DPT-6 sphere commenced.

The DPT-6 sphere was built containing the DPT-2 sequence timer, the DPT-2 squib switch assembly, and the DPT-I transmitter. The sphere contained an active battery, complete antenna system, and fuses to simulate loadings of missing components as required to allow performance checkout of the redesigned components. The payload was floated and placed in a flight-type impact limiter.

The initial test was design proof test vibration. The sphere was vibrated as a component in three planes in test setup as shown in Figures 9 and 10 to component proof test levels. The redesigned components were unaffected by vibration; however, a caging foot failure occurred. Post-mortem analysis revealed that the caging foot had retracted; there was no structural failure. The retaining disk which is held by friction

FIGURE 9. DPT-6 VIBRATION TEST - VERTICAL PLANE

FIGURE 10. DPT-6 VIBRATION TEST - LATERAL PLANE

had twisted, thereby releasing the caging foot. This failure had never occurred before and is apparently due to increased vibration levels. With the symmetrical vent installation, peak g levels on the sphere had reached 10 g. In previous configuration tests, the peak g levels on the sphere were below 6 g. Qualification of the gaging foot was accomplished at the lower levels. As a result of this failure, the symmetrical vent mounting brackets have been redesigned to reduce their stiffness and consequently to reduce the vibration amplification to the sphere to the original levels. Tests are being conducted to confirm the reduced levels.

After the vibration test, the lunar sphere was subjected to simulated lunar impact in the Hyge machine. The lunar sphere was impacted at a velocity of 200 ft/sec. The impact test fixture was placed at 45 deg to the path of travel and provided an initial bounce impact and a rebound 90-deg impact. The transmitter output was received on the Empire Devices Spectrum Analyzer and recorded on the CEC Oscillograph. Transmitter output stopped instantaneously upon impact. Post-mortem of the transmitter revealed intermittent contact of one of the ground straps clamped under a capacitor. The ground strap is made of soft metal, and apparently the impact caused enough distortion to relieve the attaching pressure. As a result of this test, the grounding method was changed to include a silver-filled epoxy connection between the capacitor, ground strap, and transmitter housing. This silver-filled epoxy is covered by potting with hard epoxy to prevent shifting during impact. Subsequent sled tests have indicated the suitability of this change.

In addition to the intermittent ground, it was determined that one of the flat dipped capacitors had come unbonded, although electrical continuity was not interrupted. As a result, however, additional extensive changes in bonding procedures are being made, and a number of additional sled tests are programmed. Results thus far indicate complete and consistent impact survival.

Post-mortem checks of the squib switch and sequence timer showed no change in performance due to impact. When the sequence was initiated, all functions were performed within 1 sec of the scheduled time, well within the specification limits.

b. <u>Ancillary Equipment</u>

(1) <u>Power and Sequencing Assembly</u>

The redesign of the power and sequencing assembly has been completed and a design proof model is currently being fabricated. The design changes which were incorporated in this unit were described in the

Thirteenth Bimonthly Technical Progress Report, Development of a Lunar Seismometer Capsule Subsystem for Ranger, Publication No. U-1743. An additional change which was not described is the replacement of the acceleration switch and its associated arming timer with a pressure switch which will automatically arm the power and sequencing assembly at an altitude of 25,000 ft. All tests which were performed on the new switch indicate that improved reliability of the power and sequencing assembly arming system will be obtained with this switch replacement.

Design proof tests on this assembly will be completed during the month of August 1962.

(2) External Wiring

The redesign effort for the external wiring was largely completed in June. Hardware for design proof testing was then fabricated. This hardware was reviewed at a Design Engineering Inspection on July 16, and then tested in accordance with Design Proof Test Plan B-24. The test setup is shown in Figure 11. All of the external wiring passed the test successfully. Fabrication of the Ranger 5 flight hardware was then begun.

The redesign of the external wiring resulted in a number of changes which should increase the reliability of the lunar capsule subsystem. All areas which had been troublesome during fabrication, testing, or final checkout were improved. Major emphasis was placed on simplifying the hardware and reducing the number of solder connections. The major design improvements are as follows:

(a) Lower Clamp Contact Jumpers (See Figure 12)

. Made adjustable for better alignment

. Made removable as an assembly without removing clamp

. Fingers bifurcated for redundant contact areas

(b) Junction Box (See Figure 13)

. Eliminated heat-affected PVC insulation

. Moved J-3 receptacle to a position more accessible for use and inspection

FIGURE 11. EXTERNAL WIRING TEST CONFIGURATION

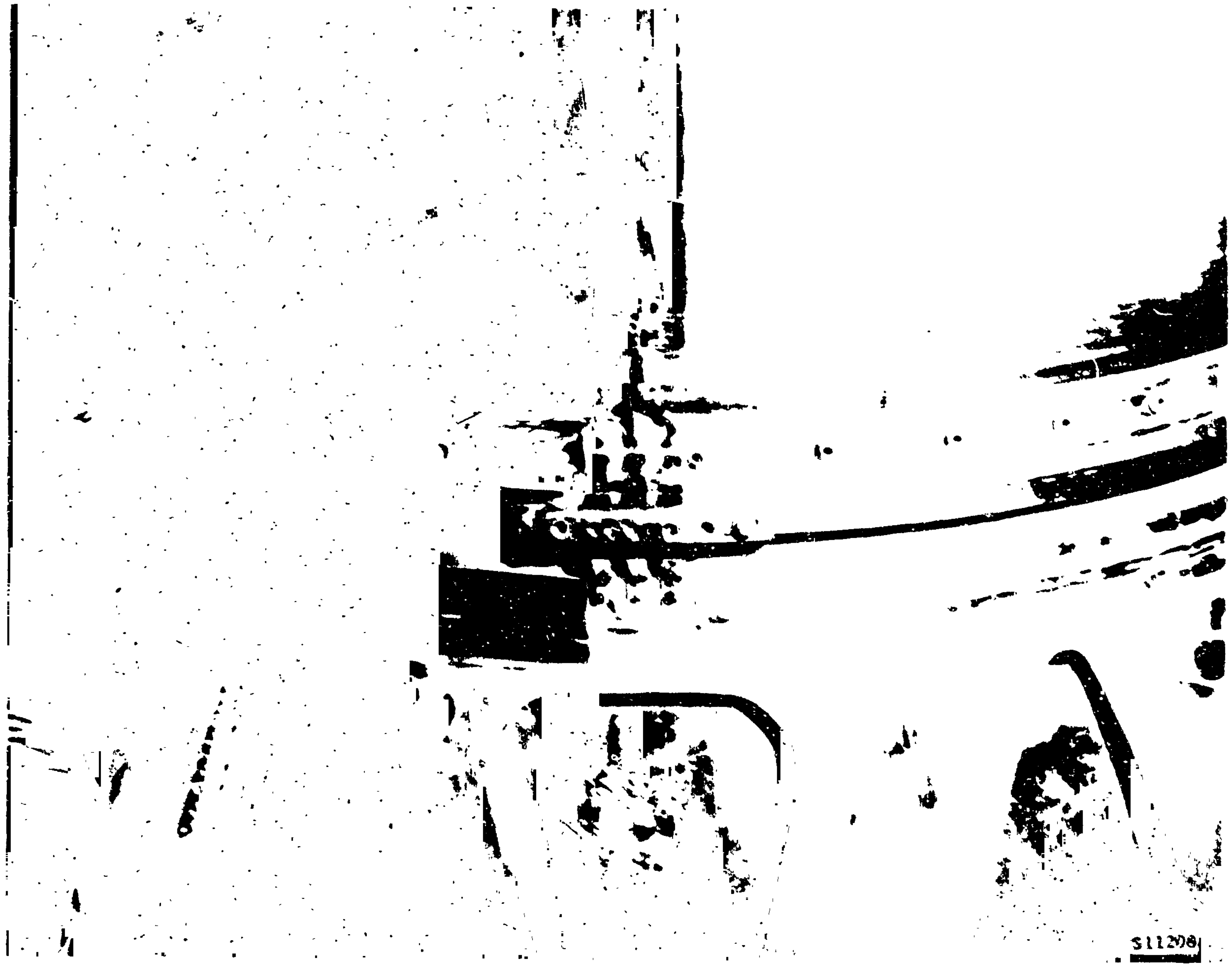
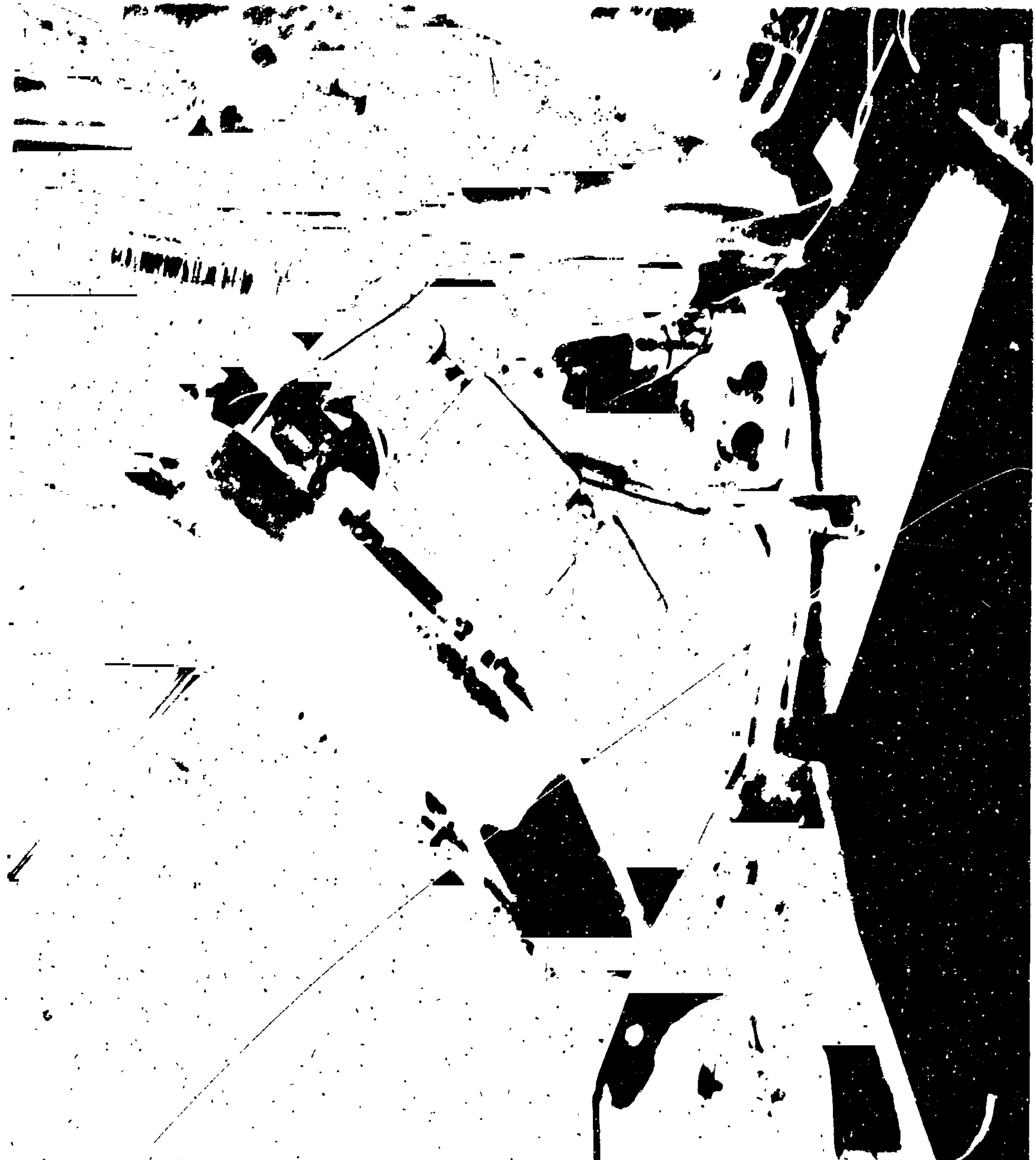


FIGURE 12. EXTERNAL WIRING - CLAMP JUMPERS



. Reduced the number of solder terminals from 26 to 12

. Changed the terminal board harness to allow it to be built and inspected outside of the box

(c) <u>Low-Torque Connector at Altimeter Hinge Joint</u> (See Figure 13)

. Eliminated this connector and its 32 solder joints

(d) <u>Separation Contacts on the Altimeter Support Structure</u> (See Figure 14)

. Eliminated these 3 pressure contacts and 9 solder connections by rerouting a cable along the structure

(e) <u>Contact Pads on the Retromotor</u>

. Changed the terminals to permit better installation of the safety shorts

(f) <u>Shield Terminations</u> (See Figure 15)

. Included the use of crimp-on ferrules for better connection to all wiring shields

The external wiring was tested at design proof levels of flight vibration and shock. The external wiring configuration included altimeter wiring, retrosupport wiring, lower clamp contact fingers, retrowiring, and dummy power and sequencing assembly. The vibration configuration consisted of the base plate, altimeter assembly, retrosupport assembly, empty retromotor case and dummy power and sequencing assembly. (See Figure 11.)

The electrical circuits were measured prior to, during and after exposure to environments. The lunar capsule electrical circuits were checked for normal resistance values essentially in accordance with Aeronutronic Specification LC(d)-147. There were no changes observed in resistance readings during or after the vibration test except as described below.

FIGURE 1[illegible]. EXTERNAL WIRING [illegible] LEADS

FIGURE 15. P&SA JUNCTION OF INTERNAL WIRING

After the lower clamp was in place and the fiberglass cover was being attached, an open circuit was observed in the "Leg F" boltcutter circuit. Evidence indicated that pressure exerted by the shield had lifted the clamp sufficiently to cause an open circuit. No open circuit was observed after the shield was removed and adjustments were made. Results of the post-vibration electrical check are shown on Table 2.

TABLE 2

ALTIMETER SUPPORT STRUCTURE WIRING
POST-VIBRATION CHECK

Test	Plug	Pin	Plug	Pin	Resistance
1	3	A	3	C	7.08
2	3	A	3	E	3.62
3	3	B	3	D	0.20
4	3	A	607	7	3.74
5	3	B	607	6	0.37
6	3	B	2	C	0.20
7	3	G	2	F	0.22
8	3	G	2	D	0.19
9	2	D	Ground		0.014
10	2	B	607	8	0.35
11	2	E	1	2	0.27
12	2	J	1	1	0.27
13	2	K	B5	(BL)	0.16
14	2	G	B5	(RD)	0.16
15	2	A	B6	(BK)	0.23
16	2	H	B6	(RD)	0.23
17	1	B	1	A	*1 <100K
18	1	C	607	3	0.27
19	1	F	607	4	0.27

*Altimeter extension switch down

During all levels of vibration continuity of altimeter boltcutter and lower clamp boltcutter contact fingers and the altimeter fuzing relay was continuously checked by instrumentation. There was no evidence of an open circuit.

(3) Gamma Ray Interference from Altimeter

It was determined that the gamma ray interference was caused by a minute particle of Cobalt 60 in the transmitter-receiver (T-R) tube in the altimeter.

The interference problem was approached in the following ways:

(a) Install lead shielding around the tube.
(b) Replace the T-R tube with one emitting alpha instead of gamma rays.

Lead shielding was installed in an altimeter assembly and tested at JPL Radiation Lab. The reduction in gamma radiation was insignificant, so further investigation of this method was dropped.

The second method was also tested at the JPL Radiation Lab. No measurable radiation was emitted from the new type T-R tube. There is apparently no degradation in performance of the altimeter due to this change in T-R tube. This change is being incorporated in the flight altimeters for Ranger 5.

Acceptance tests will start in August 1962.

(4) Systems Test Support at JPL for Ranger 5

System Tests conducted at JPL for Ranger 5 during the reporting period are as follows:

(a) Initial power turn-on subsystems and special tests
(b) Systems test and evaluation test
(c) Space simulator test
(d) Match mate and RF coupler tests
(e) Dummy run on limited compatibility test
(f) Live squib test

In general, the tests proved that the electrical interface between the lunar capsule and the Ranger 5 spacecraft is correct. All spacecraft commands which involved the lunar capsule operated pyrotechnic devices as required. Variations in altimeter AGC voltage supplied to the spacecraft data encoder during tests were observed to vary the frequency of the spacecraft telemetry channel assigned to monitor spacecraft, vidicon, and lunar capsule altimeter operation.

A fuzing signal provided through operation of the altimeter in a deep space environment operated squib simulators and this event was monitored by spacecraft GSE. The signal to cause fuzing was provided in a manner similar to actual operation.

During the live squib test, actual boltcutters and igniters were used. Spacecraft initiated commands operated altimeter-deploy boltcutters. At fuzing lower clamp boltcutters were fired, and operation of the power and sequencing assembly was initiated. Spin motor squib, retromotor squibs, and upper clamp boltcutters were fired by the P&SA.

3. STATUS OF RANGER 5 FLIGHT HARDWARE

a. Survival Sphere

(1) Upper and Lower Structures: Three sets on hand; one additional set scheduled for delivery September 1, 1962.

(2) Insulation Shells: Four sets on hand

(3) Flotation Shells: Four sets on hand

(4) Capsule Insulation: Three fabricated; one additional unit to be completed October 1, 1962.

(5) Caging Device: Four assemblies on hand

(6) Penetrators: Six assemblies are on hand; six additional assemblies are to be completed by October 1, 1962.

(7) Transmitter: Transmitters 110 and 111 have been fabricated and tuned. No difficulty was experienced with tune-up or adjustment of modulation index. Some problems with gold-epoxy bonds have been noted in transmitter 111. Bonding on this unit has been temporarily halted awaiting results of special bonding tests.

Fabrication of transmitters 112 and 113 has begun; however, further fabrication of these units is awaiting bonding test results.

(8) Sequence Timer: Two units have been fabricated and acceptance tested. Fabrication of a third unit is to begin immediately.

(9) Starter Timer: Three units have been fabricated and acceptance tested.

(10) Seismometer Amplifier: Two assemblies have been fabricated and acceptance tested. A third assembly has been fabricated and is awaiting acceptance testing.

(11) Squib Switch Assembly: Two units have been fabricated and acceptance tested. A third unit is currently being acceptance tested.

(12) Seismometers: One has been assembled and placed in the structure. Second unit has been assembled and is in rework.

(13) Switch Assembly: One assembly has been fabricated and tested. Two assemblies are currently being fabricated.

(14) Antenna: Two units fabricated and tested. A third unit is in process.

(15) Sphere 17: All electronics except transmitter have been installed in upper structure. Interconnection wiring is in process.

(16) Sphere 18: All subassemblies have been fitted into structure. Interconnection wiring of these assemblies is to begin immediately.

b. Ancillary Equipment

The status of major mechanical components other than the payload and inner shells is as follows:

(1) Impact Limiters: Two hemispheres are machined and ready for payload installation; three additional units are in machining process.

(2) Small Ordnance: All required items are on hand and qualified.

(3) Impact Limiter Covers: Four sets are on hand.

(4) Limiter Mounting Flanges: All required upper and lower flanges are on hand.

(5) Retromotors: Two motors, S/N 200 and S/N 208, are at AMR.

(6) Spin Motors: Two motors, S/N 307 and S/N 318, are on hand.

(7) Motor Support Structure Assembly: Two complete assemblies are on hand.

(8) Spin Restraint: Two units on hand.

(9) Lower Marmon Clamp Assembly: Four clamps on hand, minor wiring modification due for completion August 20, 1962.

(10) Lower Clamp Fairing: All flight requirements are on hand.

(11) Upper Marmon Clamp Assembly: All flight requirements are on hand.

(12) Vibration Dampers: All flight requirements are on hand.

(13) Thermal Radiation Shield: Flight shield is complete. Spare shield needs slight modification and will be complete by August 15, 1962.

(14) Altimeter Assembly: Both units are modified with new T-R tubes. They are in flight acceptance test process. Due for completion on September 15, 1962.

(15) Altimeter Support Structure: All parts are available from latest modification. Assembly will be complete by August 15, 1962.

(16) Capsule Batteries: Two items have been received and have passed acceptance test. Two additional units are to be delivered in August.

(17) Altimeter Batteries, Sets: Four new-design ESB batteries have been received and are being design proof tested. Five flight batteries will be delivered in September.

(18) Altimeter Battery Box: Required parts are in assembly and will be complete by August 24, 1962.

(19) Inertial Switch 5-g: All flight requirements are on hand.

(20) Power and Sequencing Assembly: All components are on hand and housings have been fabricated. Assembly of the unit is to begin approximately August 15, 1962.

(21) External Wiring Harness: One harness is complete; two additional units are in process.

4. LOG OF NONCONFORMING MATERIAL REPORTS AND ASSEMBLY SQUAWKS

On the following pages are the Assembly Squawk Sheets and the Nonconforming Material Reports (NMR's) that have been compiled during this reporting period.

Fabrication and testing effort is included and covers both components and buildup of the Ranger 5 flight capsules. Supplemental information regarding the NMR's is included in previous minutes of Management Review Board Meetings and is only summarized in this report.

3.

ASSEMBLY SQUAWK SHEETS

DRAWING NO.	SERIAL NO.	DATE	WORKMANSHIP	DESIGN	OK AS-IS	REWORK	NMR
805666G	FP-8	6-26-62	4	2	2	3	1
800033B	--	6-26-62	2	-	-	2	-
805653F	FP-8	6-26-62	1	3	3	1	-
805664E	FP-8	6-27-62	15	-	11	4	-
805665F	FP-8	6-27-62	11	-	4	7	-
801171NC	DPT-6	6-27-62	2	-	-	2	-
805666H	FP-8	6-27-62	17	3	13	5	2
805663G	FP-8	6-28-62	16	4	17	2	1
806089B	FP-9	7-3-62	7	1	6	2	-
806089B	FP-11	7-5-62	2	0	2	0	0
806084NC	FP-10	7-5-62	1	-	1	-	-
806089B	FP-10	7-5-62	2	1	3	-	-
801173A	DPT-6	7-6-62	2	-	1	1	-
806089B	FP-10	7-6-62	4	2	4	-	2
806089B	FP-11	7-6-62	2	2	2	-	2
806089B	FP-12	7-5-62	3	2	2	1	2
806084NC	FP-11	7-9-62	10	-	2	8	-
806084NC	FP-11	7-9-62	3	-	-	3	-
806070A	1209	7-9-62	2	-	-	2	-
806089B	FP-9	7-10-62	7	-	2	5	-
805944NC	FP-10	7-10-62	2	-	-	2	-
806084NC	FP-9	7-11-62	2	-	-	-	2
806084NC	FP-12	7-12-62	3	-	3	-	-
806084NC	FP-13	7-12-62	2	-	2	-	-
806084NC	FP-12	7-12-62	8	-	6	2	-
806089B	FP-11	7-13-62	6	2	5	3	-
806084NC	FP-13	7-13-62	6	-	4	2	-

Ford Motor Company,
AERONUTRONIC DIVISION

DRAWING NO.	SERIAL NO.	DATE	WORKMANSHIP	DESIGN	CK AS-IS	REWORK	NMR
806084NC	FP-11	7-14-62	1	-	-	-	1
806084NC	FP-12	7-16-62	1	2	3	0	0
806070A	FP-2	7-16-62	1	1	1	1	0
806070A	FP-3	7-16-62	2	1	1	2	0
806090NC	110	7-16-62	0	14	14	0	0
805944NC	FP-10	7-16-62	1	1	1	1	0
805944NC	FP-9	7-16-62	0	1	1	0	0
805944NC	FP-8	7-16-62	0	1	1	0	0
805682-501NC	None	7-17-62	1	1	2	0	0
805682-503NC	None	7-17-62	3	1	2	2	0
805944NC	FP-10	7-17-62	2	0	2	0	0
806090NC	110	7-17-62	9	0	1	8	0
806084NC	FP-13	7-18-62	4	0	1	1	2
806089B	FP-10	7-18-62	1	0	1	0	0
805944NC	FP-8	7-18-62	8	0	6	2	0
805944NC	FP-9	7-18-62	4	0	4	0	0
805116NC	FP-11	7-19-62	0	3	0	0	3
806090NC	113	7-21-62	2	0	1	1	0
800024C	019	7-21-62	3	0	0	2	1
805649G	FP-8	7-23-62	12	1	12	1	0
805134	FP-11	7-23-62	5	0	5	0	0
805269A	None	7-24-62	1	0	1	0	0
806496NC	FP-8	7-24-62	10	4	8	6	0
806496NC	FP-9	7-25-62	9	4	8	5	0
805348A	FP-15	7-25-62	5	0	4	1	0
806090NC	110	7-26-62	26	0	13	13	0
801171NC	None	7-26-62	1	1	2	0	0
805619H	11	7-26-62	2	0	2	0	0
806496NC	FP-8	7-27-62	2	0	1	1	0

DRAWING NO.	SERIAL NO.	DATE	WORKMANSHIP	DESIGN	OK AS-IS	REWORK	NMR
801171NC	None	7-27-62	2	0	1	1	0
806084NC	FP-11	7-27-62	2	0	0	0	2
806496NC	FP-10	7-28-62	7	1	4	4	0
806496NC	FP-10	7-28-62	7	1	3	5	0
	TOTAL		276	60	201	114	21
	PERCENT OF TOTAL		82	18	60	34	6

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NONCONFORMING MATERIAL LOG

DRAWING NO.	PART NAME	NMR NO.	NMR DATE	REASON FOR REJECTION	CORRECTIVE ACTION REQUIREMENTS	STATUS
805274	Bias Booster (FP #9 & #10)	19645	6-27-62	Output voltage not within test spec.	Zeners diodes to be selected in future.	See NMR #18218 (below)
806084	Bias Booster (FP #10)	18218	7-5-62	Output voltage not within test spec.	Failure report to be provided prior to encapsulation of future modules.	Failure Report recvd 11 July 1962
					Additional reliability report forthcoming.	Failure analysis recvd 18 July 1962.
806089B	VCO and Post Amp. (FP #11)	18219	7-6-62	Wires incorrect per assembly plan 806617A.	Assembly plan to be revised.	In type 7-19-62. Closed.
SCM157 - HPO15A2	Capacitor	19740	6-25-62	Excessive current leakage during Qualification test.	Failure analysis to be conducted by Reliability.	Texas Instruments preparing a report.
					Lot to be scrapped and new type capacitor to be used for flight.	U.S. Seacor capacitor replaces TI. Lot qualified 11 July 1962. PN 806480, 180 uf. Closed.
806090-1001	Transmitter Assy.SN111	18040	6-22-62	Tapped hole for cover screw intersects with holding screw for R32 and R16 pot.	None stated on NMR. Dwg. change req'd to either eliminate screw or modify length.	

NONCONFORMING MATERIAL LOG (Continued)

DRAWING NO.	PART NAME	NMR NO.	NMR DATE	REASON FOR REJECTION	CORRECTIVE ACTION REQUIREMENTS	STATUS
JPL 11000	Seismometer SN 9	19650	7-9-62	Pins and hook terminals bent - apparently due to handling.	Specific instructions covering seismometer handling to be issued by Project.	Handling instructions issued in Memo SCPS-32, dated 16 July 1962. Closed
805729NC	Tee	18060	7-18-62	Threaded connector on tee broke loose from main body.	Personnel were cautioned not to apply excessive torque during assy. (1 unit scrapped.)	Assy procedure and inspection procedure checked and found satisfactory. Closed.
805680C	Transmitter SN108 (DPT-6)	18099	6-12-62	Crack in transmitter housing between power and buffer cavities.	Report on DPT-6 will describe condition of hardware before and after test - will ref NMR18099.	
806064NC	Bias Booster (PP-9)	18225	7-11-62	Potting removed from terminal #8 during machining operation. Acceptance test conducted to 806519, should be 805563.	Defect occurred due to incorrect mounting of part in mold. Acceptance test to be re-run per 806563.	Technician has been reinstructed, recurrence not expected. Test completed and acceptable Closed

NONCONFORMING MATERIAL LOG (Continued)

DRAWING NO.	PART NAME	NMR NO.	NMR DATE	REASON FOR REJECTION	CORRECTIVE ACTION REQUIREMENTS	STATUS
806084NC	Bias Booster (FP-11)	18058	7-16-62	Output voltage @ 15 vdc and 18 vdc should be -9.0 to -11.0, was -8.9. Output ripple @ 15 vdc and 18 vdc should be less than 0.02 v. ptop, was 0.03.	EO 26872 issued replacing 806254 diode with an 806176.	Closed.
806084NC	Bias Booster (FP-11 & 13)	18228	7-18-62	0.57 $^{+.00}_{-.03}$ dimension is 0.615.	Information on how to build to dimension is to be incorporated on print.	[illegible] A26884 released. Closed.
				Ends of CR-10 diode cracked at body (FP-13).	None. Cracks are in paint only, not in body.	Closed.
805116NC	Sequence Timer (FP-11)	18229	7-19-62	Polarity and identification of C-3 capacitor not shown on blueprint or mylar. Cathode end of CR3003 now shown on blueprint.	Drawing to be revised.	EO A26277 released 7-27-62. Closed.
800245NC	Aneroid Switch (SW 101)	18230	7-20-62	Actuation pressure is 13.5 in. of Hg, should be 6.1 ± 4.1 in. of Hg.	This is one switch from a lot of ten and was returned to supplier for replacement.	Closed.

NONCONFORMING MATERIAL LOG (Continued)

DRAWING NO.	PART NAME	NMR NO.	NMR DATE	REASON FOR REJECTION	CORRECTIVE ACTION REQUIREMENTS	STATUS
800024C	Caging Assy.	18233	7-23-62	Chip broken from edge of assembly.	None, cause undeterminable.	Closed. Personnel advised.
805777MC	Voltage Control Oscillator (SN 1488, 1489, 1490, 1491)	18068	7-24-62	Input impedance is 333K, should be greater than 450K.	See minutes of Mgt. R'vw. Board meeting dated 26 July 1962 concerning NMR #19702.	
305619H	Seismometer Assy. (SN 017)	18224	7-24-62	X rays of bulkhead potting show voids in excess of 1/8".	Alone. Unit reworked. (This is an inherent condition with RTV-11.)	Closed.
805116MC	Sequence Timer (FP-11)	18231	7-26-62	Capacitor C-3 pulled against transistor Q-1 causing pre-loaded weld joint.	None. Operator is aware of condition.	Closed.
805607C	Antenna Assy.	19694	7-27-62	Axial ratio is 1.3 db, should be 1.0 db or less.	None. (See NMR.)	
				Test equipment uncalibrated.	Not required - See EO A26303.	